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Alternative Work Practices and Quit Rates: Methodological Issues and Empirical Evidence For Canada

by René Morissette and Julio Miguel Rosa

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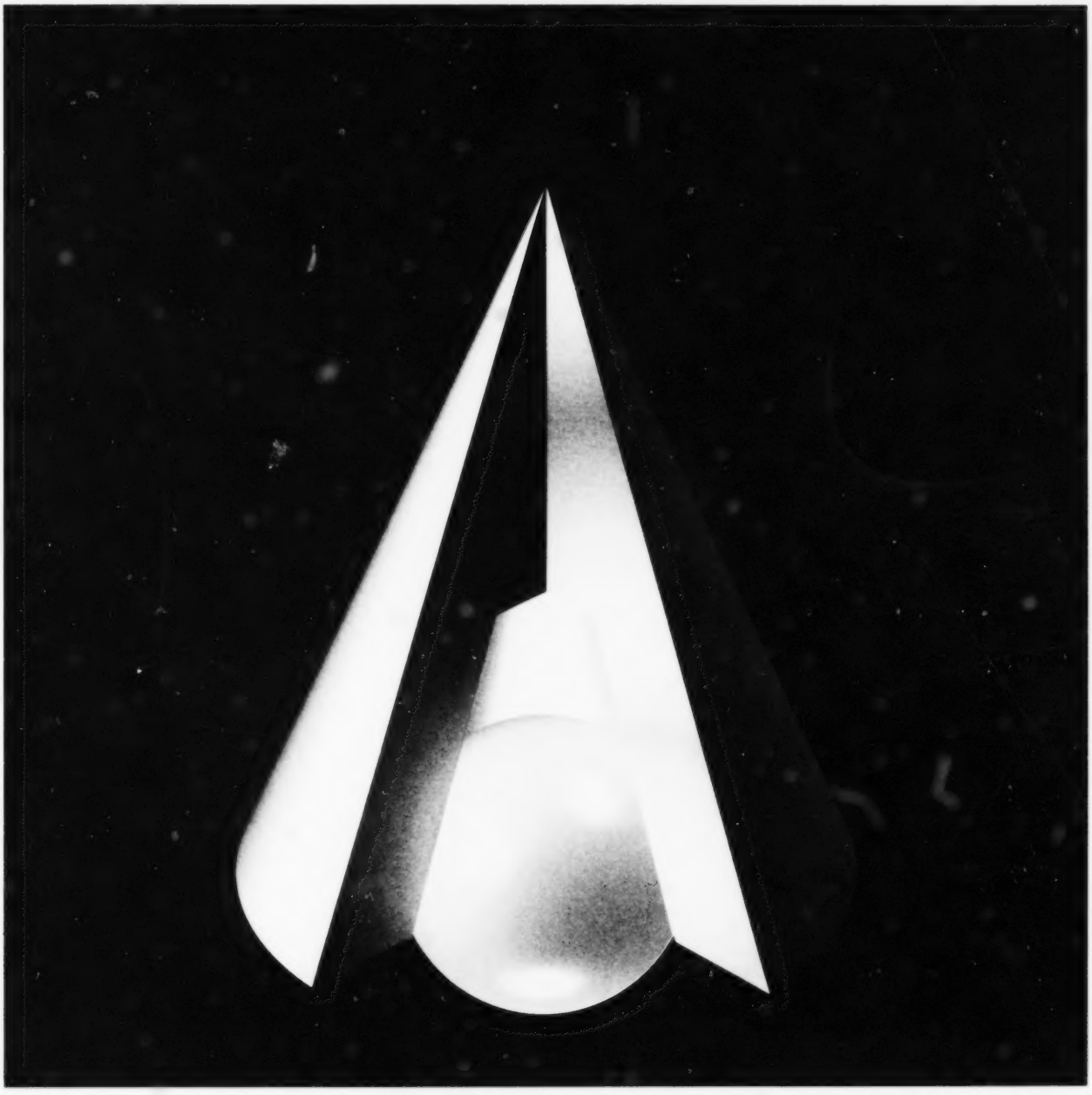

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Publications Review Committee
Analytical Studies, Statistics Canada
24th Floor, R.H. Coats Building
Ottawa, Ontario, K1A 0T6
(613) 951-1804

103-05011/

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by René Morissette* and Julio Miguel Rosa

11F0019 No. 199
ISSN: 1205-9153
ISBN: 0-662-33659-3

Business and Labour Market Analysis Division
24-F, R.H. Coats Building, Ottawa, K1A 0T6
*Statistics Canada (613) 951-3608
Facsimile Number: (613) 951-5403
E-mail: moriren@statcan.ca

The paper is available on Internet: (www.statcan.ca)

March 17, 2003

The authors wish to thank Richard Chaykowski and seminar participants at McMaster University for their helpful comments. Remaining errors and imprecisions are ours.

This paper represents the views of the authors and does not necessarily reflect the opinions of Statistics Canada.

Aussi disponible en français

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ABSTRACT

Using a nationally representative sample of establishments, we examine whether selected alternative work practices (AWPs) tend to reduce quit rates. Overall, we find only moderate support for the notion that AWPs reduce quit rates. Our analysis provides strong evidence of a negative association between these AWPs and quit rates among establishments of more than 10 employees operating in high-skill services. We also find some evidence of a negative association in low-skill services. However, the magnitude of this negative association is reduced substantially when we add an indicator of whether the workplace has a formal policy of information sharing. There is very little evidence of a negative association in manufacturing. While establishments with self-directed workgroups have lower quit rates than others, none of the bundles of work practices considered yields a negative and statistically significant effect. We conjecture that key AWPs might be more successful in reducing labour turnover in technologically complex environments than in low-skill ones.

Keywords: labour turnover; quit rates; alternative work practices; employee involvement; teamwork; human resource practices

I. Introduction

Over the last decade, a fast-growing literature has attempted to assess whether alternative work practices (AWPs) improve labour productivity, increase firms' profitability and reduce labour turnover. The general presumption is that there exists a set of "high performance" work practices which, under certain conditions, will improve employees' well-being and lead them to be more productive, thereby causing both an increase in labour productivity and a reduction in labour turnover.

Given the demographic pressures firms will likely face in the near future as a result of the aging of their workforce, the idea that some work practices may help reduce turnover and allow employers to keep key employees in the firm is quite attractive. An important challenge for researchers is to precisely identify which work practices, if any, are crucial in reducing quit rates, to determine the conditions under which these work practices may be applied most successfully and to estimate the magnitude of the causal impact of these work practices.

While past research has generally found a negative association between AWPs and quit rates, it has been subject to several limitations. First, most previous studies have used cross-sectional data and thus have been unable to establish whether the negative association between AWPs and quit rates reflects a causal impact of AWPs or some other confounding factors. In the absence of longitudinal data, the possibility that firms which use AWPs had lower quit rates *before* adopting these practices cannot be ruled out. Second, the possibility that AWPs may be endogenous with respect to quits has never been considered. Third, the endogeneity of wages with respect to quits has rarely been taken into account. Fourth, the econometric models used in some of these studies have not allowed for the possibility that regressors may have distinct effects on the probability of firms having positive quits and on conditional quit rates, an important pattern found in the data. Given these limitations, there is a clear need for identifying the methodological issues researchers face when trying to assess the impact of AWPs on quit rates. The first goal of this study is to highlight these methodological issues.

Once these methodological issues have been identified, researchers need to specify clearly the hypothesis to be tested and—most important—to ensure that the hypothesis tested can be falsified.

In its broader version, the hypothesis that AWPs reduce quit rates is extremely difficult to falsify. This is so for at least three reasons. First, the definition of AWPs varies widely across studies (Becker and Gerhart, 1996). Second, while the literature on AWPs generally argues that bundles of work practices matter, it provides little guidance on which bundles should be examined. As a result, the number of potentially relevant bundles grows exponentially with the number of work practices considered.[1] Third, it is sometimes argued that these bundles of work practices, however defined, are successful only in certain circumstances. Yet, the literature on AWPs is unclear about what these circumstances are. As a result, assessing whether AWPs reduce quit rates in a way which exhausts all possibilities is almost impossible.

[1] To get a sense of the problem, if one considers the presence/absence of four work practices in a workplace, the number of bundles with at least two work practices equals 11, i.e. $2^n - (n+1)$, where $n = 4$. If one considers 10 work practices, the corresponding number of bundles equals 1,013.

A natural avenue is to focus attention on a subset of key AWPs. In our view, teamwork, flexible job design, performance-based pay systems and formal training aimed at improving workers' ability to work in teams are four fundamental components of AWPs. This is so for several reasons. First, of all alternative work practices, teamwork is the most studied in prior research (Cappelli and Neumark, 2001a: p.742). Second, by its very nature, teamwork—at least in its most intensive form such as self-directed workgroups—is likely to be implemented in conjunction with flexible job design. Third, it is often argued that new forms of work organization—such as teamwork—which attempt to elicit greater effort from workers should be accompanied by alternative compensation schemes such as profit sharing, gain sharing, merit pay or skill-based pay. Finally, because employees who work in teams may need more skills than those in traditional work environments (Bailey et al., 2001: p.527), formal training on various aspects such as group decision-making problem-solving, leadership and communication is likely a crucial element which allows workers to perform successfully the tasks they are expected to accomplish in a new work environment.

While several studies conducted in the past decade have found a negative association between AWPs and employee turnover, most of these studies have restricted their attention to a narrow set of firms or industries.[2] Therefore, whether key AWPs reduce quit rates in all sectors of the economy remains an open question.

The second goal of this study is to answer this question, i.e. to assess whether there is a negative association between key AWPs and quit rates in all industries. To do so, we use a nationally representative sample of establishments and investigate whether the patterns observed in the aggregate are widespread or mask markedly different patterns across industries. Like many previous studies, our investigation uses cross-sectional data and thus, cannot rule out the possibility that the correlations found in regression analysis were observed before the adoption of AWPs. However, unlike most previous studies, our empirical analysis deals with the endogeneity of AWPs and wages with respect to quits. Furthermore, contrary to all previous studies, our study uses econometric models which allow regressors to have distinct effects on the probability of a firm having positive quits and on conditional quit rates. This enables us to check whether our results are robust across econometric models.

As mentioned above, the literature on AWPs generally considers bundles of work practices, whose definition varies widely across studies. While there may be synergies among work practices, such a strategy does not allow researchers to identify which components, if any, are crucial in reducing quit rates. Furthermore, individual work practices may have opposite effects on employees' propensity to quit (Batt et al., 2002). We deal with these issues by considering both the individual effect of the work practices analyzed as well as synergies among these practices. Since the literature on AWPs provides little guidance on which bundles of work practices should be examined, we follow Cappelli and Neumark's (2001a) strategy of pre-specifying combinations of work practices, based on theoretical arguments.

The paper proceeds as follows. We first provide an overview of previous studies on AWPs and employee turnover (Section II). Next, we identify the methodological issues which arise when trying to assess the impact of AWPs on quit rates (Section III). In Section IV, we discuss the

[2] As will be pointed out below, Huselid (1995), Delaney (1996) and Cappelli and Neumark (2001b) are notable exceptions.

hypotheses tested in the paper. We describe the data and concepts used in Section V. We investigate whether establishments which have key AWPs have lower quit rates than others in Section VI. Concluding comments follow.

II. Overview of prior research

Previous studies on AWPs and quit rates can be divided into two groups. A first set of studies examine employee turnover for a relatively narrow set of industries or establishments (Havlovic, 1991; Wilson and Peel, 1991; Buch, 1992; Arthur, 1994; Hamilton et al., 2001; Batt et al., 2002). Using time series monthly data on a manufacturing firm from 1976 to 1986, Havlovic (1991) finds that quality of work life initiatives reduce absenteeism, minor accidents, grievances and quits. Wilson and Peel (1991) use pooled cross-sectional time series data on quits and absenteeism for 52 engineering and metal working firms in the UK and find that firms with profit-sharing schemes and employee participation in decision-making have lower quit rates and absenteeism rates than others. Buch (1992) reports a negative association between employee turnover and quality circles for four organizations.[3] Arthur (1994) examines 30 steel minimills and finds that labour turnover is lower in plants with "commitment human resource systems" than in other plants. Hamilton et al. (2001) analyze individual-level job duration data in one garment plant in California and find that workers' probability of leaving the plant fell after the introduction of teams. Batt et al. (2002) study firms in the telecommunications industry and find that those with employee participation in offline problem-solving teams and self-directed workgroups have lower quit rates than others.

A second set of studies analyze labour turnover and AWPs for a broader set of industries (Delaney, 1996; Huselid, 1995; Cappelli and Neumark, 2001b; Azfar and Danninger, 2001). Delaney (1996) studies 495 large companies and finds that the number of AWPs implemented by a firm is negatively associated with its quit rate. Huselid (1995) uses a national sample of 855 firms with more than 100 employees and reports that those with a cluster of AWPs have lower employee turnover than others. Using the U.S. National Employers Survey, Cappelli and Neumark (2001b) examine quit rates among establishments with 20 or more employees and find that in manufacturing, establishments with self-directed workgroups, job rotation and profit-sharing have lower quit rates than others. Azfar and Danninger (2001) use the National Longitudinal Survey of Youth and find some evidence that in non-unionized jobs, young men participating in profit-sharing plans are less likely to quit than others.

Taken together, these findings appear to be consistent with the notion that AWPs tend to reduce quit rates. Yet, the available evidence is subject to several caveats. First, the results are not necessarily robust across industries. For instance, Cappelli and Neumark (2001b) find that the negative association between quit rates, on one hand, and self-directed workgroups, job rotation and profit-sharing, on the other, does not hold outside the manufacturing sector. Second, the majority of the aforementioned studies use cross-sectional data on establishments and, consequently, are unable to control for unobserved establishment-specific fixed effects—such as management quality—which may influence quit rates substantially. The only exceptions are Havlovic (1991), Buch (1992) and Hamilton et al. (2001), which do so implicitly by examining

[3] The four organizations studied were: a bank, a manufacturing plant, a hospital and a university.

longitudinal data on quits in a single establishment.[4] Third, some of the aforementioned studies (Arthur, 1994; Huselid, 1995) include both quits and layoffs in their measure of employee turnover. If AWPs and layoffs are jointly determined by changes in product markets or technology—rather than AWPs determining layoffs—then the coefficient for AWPs in an employee turnover equation no longer has a causal interpretation. Fourth, in all studies using cross-sectional data on establishments, no attention is paid to the possible endogeneity of AWPs with respect to quit rates and little attention is paid to the endogeneity of wages. Finally, as we shall argue below, the econometric models used in some of the previous studies impose some restrictions which may not be supported by the data.

III. Methodological issues

III.1 Data limitations

To study the impact of AWPs on quit rates, researchers would ideally use a longitudinal data set on workers and establishments and in which AWPs would be implemented randomly on workers and establishments. This would allow them to control both for unobserved establishment-specific and person-specific effects and ultimately, enable them to estimate a "treatment" effect for AWPs. Of course, such a data set does not exist currently. Furthermore, as we will argue below, the adoption of AWPs by firms as well as the selection of workers into AWPs are unlikely to be random.

To date, the data sets available to most researchers contained only cross-sectional data on quit rates and AWPs at the establishment level. These data sets usually ask whether an establishment uses an AWP in year t and if so, how many workers are involved in this AWP. Usually, an establishment which does not use an AWP in year t is not asked whether it adopted it in the past and abandoned it later.

Three methodological issues arise when using such data sets. First, any correlation between AWPs and quit rates may be due to unobserved establishment-specific effects. For instance, firms which use AWPs may have lower quit rates than others simply because they have better managers than others. Second, if establishments which use AWPs in year t had lower-than-average quit rates *before* they adopted AWPs, then cross-sectional statistics will overestimate the impact of AWPs on quit rates.[5] The opposite conclusion follows if these establishments had higher-than-average quit rates. Third, if some establishments which adopted AWPs in the past abandoned these practices because they did not succeed in reducing their quit rates, then cross-sectional estimates will overestimate the extent to which AWPs reduce quit rates. The reason is that—unless the data set contains information on abandonment of AWPs—these establishments will be included in the group of establishments not using AWPs in year t.

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[4] Buch (1992) uses longitudinal data on turnover for one manufacturing plant. She finds that turnover fell in that plant following the implementation of quality circles.

[5] We assume here that AWPs tend to *decrease* quit rates. For instance, suppose that: 1) establishments A, which had AWPs in 1999, had an average quit rate of 9% *before* adopting AWPs, 2) that establishments B had an average quit rate of 10%, constant over time and, 3) that the adoption of AWPs reduced quit rates of establishments A by 2 percentage points, i.e. from 9% to 7%. Comparing quit rates of establishments A to those of establishments B in 1999 would lead a researcher to conclude that AWPs reduce quit rates by 3 percentage points.

Evidently, longitudinal data on quit rates and AWPs at the establishment level would solve these two problems. Yet, even with such longitudinal data, estimating the causal impact of AWPs on quit rates is not trivial. For instance, it is reasonable to argue that the probability of an establishment adopting AWPs is not random, but rather depends *at least partly* on the reduction in quit rates expected as a result of their implementation.[6] If so, establishments which adopt AWPs could be those for which AWPs are most likely to succeed in reducing their quit rates: others would not adopt AWPs. In this context, using longitudinal data on establishments and comparing quit rates before and after the implementation of AWPs would over-estimate the causal impact of AWPs on quit rates.[7]

III.2 Sorting effects

The high performance literature generally assumes that AWPs reduce quit rates by increasing the well-being of the existing workforce. For instance, it is hypothesized that teamwork might lead employees to have a greater sense of control over their work environment and perform less repetitive tasks, thereby reducing their probability of quitting. This argument must be nuanced in five ways.

First, AWPs could reduce quit rates by inducing a *sorting* (hiring) of new workers into (by) establishments adopting these practices. To see this, consider an economy which consists of two firms in which there are initially no AWPs. Furthermore, assume that in each firm (A and B), half of the workers prefer working with AWPs while the remaining half prefers traditional work arrangements. If firm A starts using AWPs for its whole workforce, it will likely induce quits among those of its workers who prefer traditional work practices but also among workers of firm B who prefer working with AWPs. Shortly after the adoption of AWPs by firm A, quit rates of both firms are likely to rise. Eventually, firm A (B) will likely succeed in hiring workers of firm B (A) who prefer working with (no) AWPs. In the longer run, both firms will likely end up with lower quit rates than initially because the adoption of AWPs and labour mobility will have allowed—for both firms—a better match between workers's preferences and firms' work arrangements. In this setting, firm A, which has implemented AWPs, will not necessarily end up with lower quit rates than firm B.

Second, AWPs may increase workers' well-being but not reduce quit rates.[8] For instance, the adoption of teamwork may increase the well-being of the existing workforce without reducing

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[6] As pointed out by Freeman et al. (2000: p.1), economic as well as non-economic factors may influence the adoption of AWPs: "Some [firms] adopt [AWPs] [...] because they are near bankruptcy and see devolving authority as a possible "way out". Others do it because they believe it is a more profitable or morally better way to operate their business. Yet other firms do it because other firms do it."

[7] Such an exercise would nevertheless be useful since it would provide an upper bound for the extent to which a *random* implementation of AWPs can reduce quit rates.

[8] Godard (2001) shows that the use of flexible work practices is associated with improvement in workers' outcomes such as "belongingness", empowerment and job satisfaction, at least at moderate levels of adoption. Appelbaum et al. (2000) find that flexible work practices are associated with greater trust, commitment and job satisfaction. Freeman et al. (2000) show, among other things, that the majority of workers participating in employee involvement programs report benefitting from these measures by having more influence on their job.

quit rates if it also raises the portability of workers' skills, thereby increasing their labour market opportunities outside the firm.[9]

Third, a given AWP may influence quits through various channels which may have opposite effects. For instance, the introduction of teamwork may lead to a decrease in wages for some highly productive employees moving from an individual piece rate system to a group piece rate system (Bailey et al., 2001). The resulting wage losses suffered by these workers may induce them to quit. This effect may offset partially or completely the decrease in quit rates that teamwork—by giving workers more control over their work environment—might induce.

Fourth, individuals may have heterogeneous preferences regarding the organization of their work and the extent to which they are involved in decision-making. A given work practice may increase the well-being of some workers while decreasing the well-being of others. For instance, while job rotation may allow some workers to perform a richer set of tasks, it may also increase the level of stress faced by others who have difficulty mastering the potentially greater complexity of the job resulting from this practice.[10]

Fifth, if the adoption of AWPs lead to an intensification of work effort, their effectiveness in reducing quit rates may be attenuated.[11]

III.3 Endogeneity of AWPs

While the high performance literature emphasizes the potential AWPs have in reducing quit rates, it is generally silent on the extent to which the adoption of AWPs can be triggered by excessively high quit rates. More precisely, some of the AWPs in use in year t may have been adopted in year t in response to a high number of quits observed during that year. Without information on the date of implementation of AWPs, researchers using cross-sectional establishment-level data have to rely on instrumental variables to correct for the potential endogeneity of AWPs with respect to quit rates. Past research has not addressed that issue.

In this study, we take advantage of the fact that our data set contains information on the year of implementation of (several) AWPs and omit from our analysis all establishments which have implemented AWPs in year t. As a result, our analysis essentially compares establishments which have introduced AWPs *prior to year t and are still using them in year t* to those which are not using AWPs in year t.

While this strategy should alleviate concerns regarding the endogeneity of AWPs, it is instructive to lay out clearly the assumptions which must be made in order to solve thoroughly the endogeneity problem. To see this, simply define:

P(A) = probability of having adopted an AWP prior to year t

[9] Subjective data such as those used by Freeman et al. (2000) may be useful to examine whether AWPs increase workers' well-being.

[10] Godard (2001) provides evidence that the adoption of AWPs is associated with more stressful work.

[11] The potential increase in quit rates resulting from work intensification may not materialize if employers compensate workers for greater effort by offering them higher wages.

P(B) = probability of using an AWP in year t
P(A Ω B) = probability of having adopted an AWP prior to year t and using it in year t
P(B | A) = probability of using an AWP in year t conditional on having adopted it prior to year t;

Then, it follows that:

$$P(A \Omega B) = P(A) * P(B \mid A) \qquad (1)$$

In other terms, P(A Ω B) , the probability of having adopted an AWP prior to year t and using it in year t, is the product of the probability of having adopted this AWP in the past and the probability of using this AWP in year t conditional on having adopted it in the past. The probability of having adopted an AWP in the past, P(A), is unlikely to be influenced by (random shocks on) quits in year t. However, P(B | A), a firm's decision to maintain the use of an AWP in year t after having adopted it in the past, could be influenced by quits in year t.

The question then becomes whether firms use information on quits in year t to decide to maintain an AWP in that year or whether they make this decision based only on quits in previous years. While we cannot decisively solve this issue, it is reasonable to argue that there are adjustment costs associated with the abandonment of AWPs. In this context, firms which experience unsatisfactory results—in terms of quits—with an AWP in year t may wait some time before deciding to abandon this AWP. If so, a high number of quits in year t would influence the decision to maintain the use of an AWP only in year t+1 or in subsequent years. Hence, to overcome the endogeneity of AWPs, researchers must assume that a firm's decision to maintain the use of an AWP in year t after having adopted it in the past is not influenced by quits in year t. We make this assumption in Section VI.

III.4 Endogeneity of wages

There are at least two reasons why wages paid by firms may be endogenous with respect to quit rates. If firms are wage setters which incorporate the cost of labour turnover (i.e. training and hiring costs) into their optimizing process, then quit rates and wages will be determined simultaneously (Mortensen, 1998). For instance, efficiency wage arguments suggest that firms with high training costs might pay their workers higher-than-average wages in order to obtain lower-than-average quit rates.

A second reason why wages may be endogenous with respect to quit rates rests on a disequilibrium argument. If random shocks lead to higher-than-optimal quit rates, then firms may respond to these shocks by increasing wages during that year, perhaps temporarily.

While both arguments are plausible, surprisingly little attention has been devoted to the potential endogeneity of wages in studies of the relationship between AWPs and quit rates. Of all previous studies using cross-sectional establishment-level data, Wilson and Peel (1991) is the only one which attempts to correct for the endogeneity of wages.[12]

[12] They do so using instrumental variables. Cappelli and Neumark (2001b) use the residual from a regression of establishment-level wages on controls for workforce characteristics and establishments characteristics as their wage measure. Such a residual may be influenced by random shocks on quits in year t and thus does not overcome the endogeneity of wages.

In Section VI, we take advantage of the fact that our data set contains information on establishment-level wages in year t-1 and use these as an instrument for wages in year t. Since random shocks ϵ_{jt} on quits of establishment j in year t are uncorrelated with wages in year t-1, this helps reduce concerns regarding the endogeneity of wages.

Yet, additional assumptions must be made in order to claim that lagged wages are exogenous with respect to quit rates. Suppose the quit rate of establishment j at time t, Y_{2jt}, is given by the following equation:

$$Y_{2jt} = X_{2jt}\beta + u_{2jt};\ u_{2jt} = \omega_j + \epsilon_{jt} \qquad (2)$$

where the error term u_{2jt} contains, not only random (or idiosyncratic) shocks ϵ_{jt}, but also an unobserved component, ω_j, which captures unmeasured determinants of quits. Lagged wages will be exogenous with respect to quit rates only if they are uncorrelated with ω_j. This may not be the case.

To see this, suppose that the data at our disposal contains no information on training costs. Further assume that establishments with high training costs have lower-than-average optimal quit rates and higher-than-average optimal wages. In this context, establishments with high training costs will have a low value of ω_j, reflecting their lower-than-average optimal quit rates. If these establishments set their wages in year t-1 taking into account their high training costs, then wages in year t-1 will be correlated with ω_j, and therefore with u_{2jt}. Hence, the possibility that lagged wages may be correlated with quits in year t because of omitted establishment-specific factors must be kept in mind when interpreting the results of Section VI.

III.5 Choice of econometric models

In the data set used in this study, at least one third of establishments have zero quit rates. As is well-known (e.g. Maddala, 1983), using ordinary least squares methods in this context will yield biased estimates of the parameters of interest.[13] Given the concentration of observations at zero, a natural avenue is to estimate establishment-level quit rates Y_2 using a Tobit model, defined as follows (where the subscripts j and t have been omitted):

$$\begin{aligned} Y_2 &= X_2\beta + u_2 \quad \text{if } X_2\beta + u_2 > 0;\ u2 \sim N(0,\sigma_2^2) \\ &= 0 \quad \text{otherwise} \end{aligned} \qquad (3)$$

In this model, the unconditional expected quit rates equal:

$$E(Y_2) = X_2\beta * \psi[(X_2\beta)/\sigma_2] + \sigma_2 * \varphi[(X_2\beta)/\sigma_2] \qquad (3.1)$$

where φ is the standard normal probability density function and ψ is the normal cumulative distribution function.

Cappelli and Neumark (2001b) and Batt et al. (2002) use this approach. One important limitation of the Tobit model is that it assumes that if a given regressor X increases (decreases) the

[13] Huselid (1995) and Delaney (1996) use ordinary least squares methods and do not report the percentage of firms with zero employee turnover in their sample.

probability of an establishment having positive quits, $P(Y_2 > 0)$, it will also increase (decrease) establishments' conditional quit rates, $E(Y_2 \mid Y_2>0)$ [Fin and Schmidt (1984)].

In a study of job vacancy rates of U.S. establishments, Holzer (1994) shows that this restriction does not hold for establishment size. As we shall see below, the patterns documented by Holzer (1994) for job vacancies also hold in our data set for quits. Specifically, we find that large establishments are *more* likely than smaller ones to have positive quits (simply because the probability of *at least* one worker quitting his job is higher in larger establishments) but conditional on having positive quits, large establishments have *lower* quit rates than smaller ones (possibly because of the greater career opportunities that the internal labour market of large workplaces offer).

Two models do not impose the aforementioned restriction: 1) the sample selection model (or adjusted Tobit model) and 2) Cragg's (1971) model. The sample selection model can be written as follows:

$$\begin{aligned} Y_2 &= m \quad \text{if } I > 0 \\ &= 0 \quad \text{otherwise} \\ I &= X_1\alpha + u_1 \qquad (4.1) \\ m &= X_2\beta + u_2 \qquad (4.2) \end{aligned}$$

where equation 4.1 models the probability of an establishment having positive quits and where the error terms u_1 and u_2 follow a bivariate normal distribution with correlation coefficient ρ and where σ_1 is normalized to one for identification reasons:

$$(u_1, u_2) \sim N \left[\begin{matrix} (0) & (\sigma_1^2 & \rho\sigma_1\sigma_2) \\ (0) & (\rho\sigma_1\sigma_2 & \sigma_2^2) \end{matrix} \right]$$

In the sample selection model, the unconditional expected quit rates equal:

$$E(Y_2) = \{ X_2\beta + \rho\sigma_2 * \varphi [(X_1\alpha)/\sigma_1] / \psi [(X_1\alpha)/\sigma_1] \} * \psi [(X_1\alpha)/\sigma_1] \qquad (4.3)$$

While equations 4.1 and 4.2 can be estimated using Heckman's (1979) two-step procedure or using full information maximum likelihood methods (FIML), one non-trivial econometric challenge is to find—among X_1—variables which affect the probability of firms having positive quits but do not affect their conditional quit rates. As is well known (e.g. Johnston and Dinardo, 1997: p.450), in the absence of exclusion restrictions, the identification of the model depends crucially on the normality assumptions made about the error terms.[14] In practice, it is extemely hard to find factors which influence the probability of firms having positive quits but do not alter their conditional quit rates.

In contrast, Cragg's (1971) model can be written as follows:

$$\begin{aligned} Y_2 &= m \quad \text{if } I > 0 \\ &= 0 \quad \text{otherwise} \end{aligned}$$

[14] In this case, the inverse Mills' ratio used in the two-step procedure and the regressors X_2 may be highly collinear, thereby decreasing the reliability of the two-step estimation method (Leung and Yu, 1996: p.201).

$$I = X_1\alpha + u_1 \quad (5.1)$$
$$m = X_2\beta + u_2 \quad (5.2)$$

where $u_1 \sim N(0,1)$, $u_2 \sim N(0, \sigma_2^2)$ and where the two error terms are assumed to be independent. In this model, the unconditional expected quit rates equal:

$$E(Y_2) = \{ X_2\beta + \sigma_2 * \varphi [(X_2\beta)/\sigma_2] / \psi [(X_2\beta)/\sigma_2] \} * \psi (X_1\alpha) \quad (5.3)$$

Equation 5.1 can be estimated by a probit model while equation 5.2 can be estimated using truncated regression. A likelihood ratio test can be applied to test whether the Tobit model should be preferred to Cragg's model.[15] One limitation of Cragg's model is the assumption that the two error terms are uncorrelated: it is hard to justify why the error term related to the probability of having positive quits would be uncorrelated with the error term of the conditional quit rate equation.

Hence, all three econometric models contain at least one limitation. To allow a comparison of our results with those of Cappelli and Neumark (2001b) and Batt et al. (2002), we first estimate Tobit models. To ensure that our main results are robust, we also estimate the sample selection model and Cragg's model for some of the specifications used in the paper.

III.6 Non-linearities

Researchers must consider at least two types of non-linearity when analyzing AWPs and quit rates. The first type refers to the possibility that shortly after adopting an AWP, firms may experience a temporary increase in their quit rates. This may occur if some workers in the firm prefer working in traditional settings and decide to quit after the introduction of AWPs. If the introduction of AWPs eventually leads to an increase in job satisfaction for the remaining workers, quit rates may subsequently fall to a level lower than was observed prior to the adoption of AWPs. As a result, the evolution of the quit rate of a given firm may display an inverted U-shape over time. This suggests the need to allow for the possibility that the correlation between quits and AWPs may differ depending on the period of adoption.

A second type of non-linearity results from the possibility that, whereas moderate levels of adoption of AWPs may improve workers' outcomes, higher levels of adoption may worsen workers' outcomes (Godard, 2001). For instance, allowing workers to rotate to various work assignments *occasionally* may improve their motivation but doing so *frequently* might have perverse effects on their well-being.[16]

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[15] The test is: 2(ln L Probit + ln L Truncated regression – ln L Tobit) ~ $\chi 2$ with k degrees of freedom (where k equals the number of regressors).

[16] Apart from the methodological issues discussed so far, there may be—in matched employer–employee data sets—an important cognitive issue in attempting to elicit responses from employees about their participation in self-directed workgroups and problem-solving teams. Arguably, these are complex concepts for which workers may not have a clear understanding. However, workers may have a clearer understanding of simpler concepts such as employee suggestions or job rotation.

IV. Hypotheses

One of the central arguments of the literature on AWPs is that while these work practices, taken individually, may not substantially affect firms' outcomes, combining them in bundles will likely yield substantial gains in terms of greater productivity or reduced labour turnover. Since this literature provides little guidance on which practices should be combined together, we follow Cappelli and Neumark's (2001a) strategy of pre-specifying combinations of work practices, based on theoretical arguments. This strategy avoids making inferences based on very peculiar bundles of work practices and providing findings which may not be robust when considering alternative combinations.

Our focus on teamwork, flexible job design, performance-based pay systems and teamwork-related formal training allow us to test three simple hypotheses when considering synergies. The first hypothesis, H1, is that teamwork is more likely to succeed in reducing quit rates if combined with flexible job design, and vice-versa. The reason is that workers may enjoy more teamwork if they are allowed to rotate to the various tasks that the teams need to perform and may enjoy more job rotation or other forms of flexible job design if they have control, through self-management, over when and where to move.[17]

Two versions of this hypothesis will be tested. The first version will consider a bundle which combines self-directed workgroups and flexible job design (bundle 13) while the second version will combine teamwork broadly defined—i.e. including either self-directed workgroups or problem-solving teams or both—and flexible job design (bundle 23).

The second hypothesis, H2, is that teamwork will be more effective in reducing labour turnover if combined with performance-based pay systems, such as profit sharing or gain sharing. Version H2a of this hypothesis will be tested by combining profit sharing/gain sharing with self-directed workgroups (bundle 14) or with teamwork, broadly defined (bundle 24). Since teamwork may require workers to master a greater set of skills than traditional work environments, workers may expect a compensation for having to adapt and learn new skills. If so, merit pay or skill-based pay can provide the incentives necessary to induce appropriate behaviour in a new work environment. This suggests that teamwork may also be more effective in reducing quit rates if combined with these forms of compensation (version H2b). To account for this possibility, we use merit pay or skill-based pay in conjunction with self-directed workgroups (bundle 15) or teamwork (bundle 25).

The third hypothesis, H3, is that teamwork will reduce quit rates only if firms send their employees a clear signal that they are serious about it, i.e. only if they provide appropriate training on group decision-making and problem-solving. To test this hypothesis, we combine classroom training on teamwork-related issues with self-directed workgroups (bundle 16) or teamwork broadly defined (bundle 26).

We also consider five additional bundles which combine these three hypotheses. Specifically, we combine teamwork (broadly defined) and flexible job design with profit sharing/gain sharing (bundle 234), merit pay/skill based pay (bundle 235) or formal training on teamwork-related

[17] This is essentially the argument Cappelli and Neumark (2001a: p.758) apply when analyzing the impact of AWPs on firms' productivity.

issues (236). We also combine teamwork, flexible job design, alternative compensation schemes and teamwork-related formal training (bundles 2346 and 2356). Hence, we consider 13 bundles of work practices.

Our empirical strategy will proceed in three steps. First, we will examine whether key AWPs, considered individually, are associated with lower quit rates. Second, we will analyze, for each of the 13 bundles defined above, whether the joint implementation of work practices yields a negative association with quit rates. Third, we will test for synergies by estimating interaction terms for each of the eight bundles combining two work practices.

V. Data and concepts

We use data from the Workplace and Employee Survey (WES) conducted in 1999 and 2000 by Statistics Canada. WES is a linked employer-employee file. Employers are sampled by physical locations—the statistical unit that comes the closest to the concept of a workplace in which employer and employee activities can be linked. Employees are then sampled from employer-provided lists within each location.

The survey covers all industries except farming, fishing, trapping and public administration. It examines a broad range of topics such as human resource practices, labour turnover, technology adoption, innovation and business strategies, among others. The employer portion of the survey was administered in the summer and fall of 1999 using a computer-assisted personal interview (CAPI). The primary respondent was the human resource manager in a large firm and the business owner in a small firm.[18] The survey was conducted though a computer-assisted telephone interview (CATI) in 2000. The response rate of WES is quite impressive: it equals 96.5% and 95.8% in 1999 and 2000, respectively.

Our analysis of quit rates is based on the following question, asked in 2000:

"Please estimate the number of employees who have permanently left this location between April 1, 1999 and March 31, 2000, by reason:

A. Resignations (No special incentives)
B. Lay-offs (No recall expected)*
C. Special workforce reductions**
D. Dismissal for cause
E. Retirement (No special incentives)

* Involuntary lay-offs with enhanced severance packages should be included with "Lay-offs".
** Special workforce reductions include resignations and early retirements induced through special financial incentives (i.e. where employees voluntarily leave).

[18] While it may be argued that human resource managers may not have detailed knowledge about AWPs, Gittleman et al. (1998: p.104) find that answers provided by human resource persons did not systematically differ from those of line managers in the 1993 U.S. Survey of Employer Provided Training.

To construct our measure of quit rates, we divide the number of resignations (A) by the average level of employment observed between April 1999 and March 2000.[19]

Information about teamwork and flexible job design were obtained from establishments with more than 10 employees, using the following question, asked in 1999:

"For non-managerial employees, which of the following practices exist on a formal basis in your workplace:

a) *employee suggestion program* [includes employee survey feedback].
b) *flexible job design* [includes job rotation, job enrichment/redesign (broadened job definitions), job enrichment (increased skills, variety or autonomy of work)].
c) *Information sharing with employees* [for example, with respect to firm's performance, colleagues' wages, technological or organizational changes, etc. This implies that employees have some feedback on policies]
d) *Problem-solving teams* [responsibilities of teams are limited to specific areas such as quality or work flow (i.e. narrower range of responsibilities than self-directed work groups)]
e) *Joint labour-management committees* [include non-legislated joint labour-management committees and task teams that generally cover a broad range of issues, yet tend to be consultative in nature].
f) *Self-directed work groups* [semi-autonomous work groups or mini-enterprise work groups that have a high level of responsibility for a wide range of decisions/issues]"

Several points must be noted with respect to the aforementioned question. First, it refers to human resource practices which exist on a *formal* basis and thus, does not consider informal practices which may have an impact on working conditions and quit rates. Second, it specifies that flexible job design includes concepts such as job rotation and job enrichment. Third, it distinguishes at least two types of teamwork: 1) problem-solving teams, whose responsibilities are limited to specific issues and, 2) self-directed workgroups (or self-managed teams), the most intense form of teamwork. Fourth, when a firm reports having a practice, it also asks about the year of adoption of that practice. However, if a firm reports not having a work practice, it is not asked whether it implemented that practice in the past and abandoned it later. Fifth, it contains no information on the percentage of employees involved in that work practice.[20]

To analyze performance-based pay systems, we construct indicators of whether establishments had alternative compensation schemes such as profit sharing, gain sharing, merit pay and skill-based pay for *some* of their non-managerial employees in 1999. Contrary to the six work practices listed in the aforementioned question, WES provides no information on the year of implementation of these compensation schemes. We analyze formal training aimed at improving workers' ability to work in teams by constructing an indicator of whether establishments paid or provided for classroom training on group decision-making, problem-solving, team-building, leadership and communication between April 1998 and March 1999.

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[19] If an establishment has seasonal peaks in employment, the average level of employment is constructed by taking a weighted average of maximum employment during these peaks and average employment in March 1999 and March 2000. Otherwise, the average level of employment is simply the average of employment observed in March 1999 and March 2000.

[20] Note that this question was not asked in 2000.

As argued above, AWPs may be endogenous with respect to quits. To minimize concerns regarding the endogeneity of AWPs, we omit from our analysis establishments which have implemented *any* of the six practices listed in the aforementioned question. Adding this restriction to the set of selection criteria defined below drops the number of selected establishments from 3,285 to 3,142.[21]

We also distinguish establishments which adopted teamwork and/or flexible job design in 1996 or earlier from those which did so in 1997-1998. We introduce this distinction for four reasons. First, if establishments introduce work practices gradually and increase their use over time, those which adopted such practices at least two years ago may have a greater fraction of workers involved in these practices than those which adopted them more recently. If so, we may have more chances of finding a significant effect for early adopters than for late adopters. Furthermore, this strategy may help overcome the lack of information on the percentage of workers involved in AWPs. Second, if the impact of a given practice on workers' well-being takes time to operate—for instance, if workers in teams need stability to learn to work together—we may also have more chances of capturing an effect among establishments which adopted that practice early than among those which adopted it late. Third, as argued above, the introduction of AWPs may lead to a temporary increase in quit rates and a decline subsequently, at least for some workplaces. If so, establishments which implemented in 1997-1998 may have higher quit rates than others. Lastly, if establishments which adopted practices late differ from those which adopted them early in terms of management quality or other unmeasured dimensions influencing quits, quite different patterns could be found in the two groups.

To alleviate concerns regarding the endogeneity of wages, we use data on establishments' annual payroll per employee in period t-1, i.e. between April 1998 and March 1999. In order to obtain a measure of payroll which covers 12 months, we exclude from our analysis establishments which were born after March 1998. Since quit rates depend on hourly wages, rather than annual pay, we control for the number of hours worked in an establishment between April 1998 and March 1999 by conditioning our results on the percentage of employees working part-time as well as the average number of weekly hours worked by full-time employees.[22]

To ensure that the establishments analyzed represent workplaces which pay meaningful earnings, we further restrict our sample to establishments whose average payroll per employee varied between $5,000 and $200,000 (in 1998 dollars).[23] Finally, to ensure comparability with previous studies—in which the question about quits refer to the *percentage* of workers quitting—we delete establishments whose quit rates exceed 100%. As a result, our sample consists of profit-oriented establishments which operated between April 1998 and March 2000, which had more than 10 employees in March 1999, whose average annual pay per employee varied between

[21] The 143 establishments excluded represent 3% of the (weighted) population of establishments covered by the selection criteria defined below.

[22] Furthermore, we adjust our measure of annual payroll per employee by taking into account the number of person-years of temporary layoff when calculating the average number of employees.

[23] Relaxing this restriction does not alter our results.

$5,000 and $200,000 and whose quit rates did not exceed 100%. These restrictions lead to a sample of 3,142 establishments.[24]

VI. Analysis of quit rates

VI.1 Descriptive statistics

Table 1 presents the percentage of establishments with selected work practices. Data are shown both for establishments with more than 10 employees and those with 50 or more employees.[25] Between one quarter and one third of establishments report having problem-solving teams in 1999. As expected, fewer (10%-15%) report having self-directed workgroups, the most intense form of team participation. Flexible job design is found in at least one quarter of establishments. Overall, about 45% of establishments report using flexible job design or teamwork broadly defined.[26]

The right panel of Table 1 examines when these practices were implemented. Given that interest in teamwork and job design emerged in the 1970s (Cappelli and Neumark, 2001a), it is reassuring to find that the vast majority of establishments which use teamwork or flexible job design in 1999 report having adopted these practices after 1975. A non negligible fraction of workplaces adopted problem-solving teams or flexible job design quite recently, i.e. in 1997-1998.

Table 1 also provides information on the use of other practices. Of all remaining practices, information sharing is by far the most common. Profit sharing or gain sharing, merit pay or skill-based pay and teamwork-related formal training—i.e. classroom training on group-decision making, problem-solving, team-building, leadership and communication—are available to non-managerial employees in at least one-fifth of establishments.

Table 2 shows how the use of AWPs varies across industries, establishment size and union status. Except for flexible job design, large establishments are more likely than smaller ones to use AWPs on a formal basis. Not surprising, task teams and joint labour-management committees are found more often in unionized workplaces than in non-unionized ones. Self-directed workgroups are much more prevalent in forestry, mining, oil and gas extraction than in

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[24] The resulting sample is representative of establishments with more than 10 employees in terms of union status and size. It slightly underrepresents establishments in retail trade and consumer services. These establishments account for 29.5% of all establishments in our sample, compared to 32.5% in a sample of establishments with more than 10 employees in March 1999.

[25] We also analyze workplaces with 50 or more employees for two reasons. First, part of the literature on AWPs (e.g. Osterman, 2000) focuses on this size category. Second, we want to investigate whether the patterns found for establishments with more than 10 employees hold when attention is restricted to larger workplaces.

[26] It is difficult to assess the extent to which these numbers are similar to those provided for the U.S. by Gittleman et al. (1998) with the 1993 Survey of Employer Provided Training (SEPT) since the definition of AWPs differ between WES and SEPT and since the periods covered are different. Nevertheless, at least two observations can be made for establishments with 50 or more employees. First, problem-solving teams appear to be used more frequently in WES (33%) than quality circles are in SEPT (16%). Second, the incidence of flexible job design in WES (24%) is similar to that of job rotation in SEPT (24%).

other industries, probably reflecting the high incidence of self-managed teams of production workers in mining and oil and gas extraction.

Table 3 asks the following question: conditional on having adopted a practice in 1996 or earlier and using it in 1999, what fraction of establishments use other practices? The numbers convey two messages. First, self-directed workgroups are generally used in conjunction with flexible job design since roughly 75% of workplaces which have self-managed teams also have flexible job design. Second, self-directed workgroups and information sharing imply quite different degrees of employee involvement and, consequently, are combined quite differently. While the vast majority (87%) of establishments which use self-directed workgroups also have information sharing as a formal policy, only one-fifth of establishments which have information sharing as a formal policy use self-directed workgroups.

The third and fourth column of Table 4 examine the extent to which establishments used bundles of work practices on a formal basis in 1999. Both among establishments with more than 10 employees and among those with 50 or more employees, the frequency of use of most of these bundles varies between 5% and 15%. As expected, the frequency of use drops slightly when we consider establishments which adopted these practices in 1996 or earlier and were still using them in 1999 (Table 4, columns 1-2). Most important, at most 8% of establishments jointly use teamwork (broadly defined), flexible job design and alternative compensation schemes (i.e. bundles 234 and 235) on a formal basis. Futhermore, at most 5% of establishments combine the use of teamwork, flexible job design, performance-based pay systems and teamwork-related formal training (i.e. bundles 2346 and 2356). This finding is important since it suggests that either a minority of workplaces find it profitable to formally adopt combinations of AWPs or that several workplaces perhaps do so, but on an informal basis.

Table 5 compares quit rates of establishments which adopted AWPs in 1996 or earlier and were still using them in 1999 to those which did not have these practices in 1999. Among establishments with more than 10 employees, average quit rates are lower in the former group for all AWPs except flexible job design. The differences in quit rates between the two groups decrease when the focus is on establishments with 50 or more employees. Table 5 also compares quit rates of establishments with alternative compensation schemes and teamwork-related formal training in 1999 to those which did not use these practices in 1999. Average quit rates are generally lower in the former group, with the exception of establishments with more than 10 employees providing teamwork-related training.

A priori, it might be reasonable to assume that of all work practices which employers can choose, those which imply a high degree of employee involvement are the most likely to reduce quit rates. However, it is worth noting that among establishments with more than 10 employees which have *neither* teamwork, flexible job design, *nor* joint labour-management committees on a formal basis, those which use information sharing have average quit rates twice as low (8%) as other establishments (17%). Since a simple policy of information sharing neither implies a high degree of employee involvement nor is likely to affect individuals' work environment substantially, this finding raises the possibility that work practices which are fairly conventional—and of which information sharing might be a proxy—might also affect quit rates substantially. We discuss this issue in section VI.2.

Table 6 shows that the impact of establishment size on the probability of firms having positive quits differs from its impact on conditional quit rates. Large establishments are more likely to have positive quits than smaller ones. One simple explanation for this pattern is that large establishments are simply more likely than smaller ones to have at least one worker quitting his job during a given period. However, among establishments which have positive quits, large establishments display lower quit rates. Hence, the restriction imposed by the simple Tobit model is not supported by our data.

Tables 7 and 8 illustrate two key messages of this paper. The first message is that AWPs do not appear to reduce quit rates in all industries. For instance, manufacturing establishments which have some bundles of work practices do not have lower quit rates than those with no AWPs (Table 7). However, a quite different pattern is observed in high-skill services. In this sector, establishments with bundles of AWPs have much lower quit rates than those with no AWPs.

The second message is that information sharing seems to play an important role in low-skill services. In this sector, of all establishments which have adopted neither teamwork nor flexible job design in 1996 or earlier, those with an information sharing policy have much lower quit rates than others (Table 8). All we shall see below, both messages hold in multivariate analysis.

High-skill services include finance and insurance, business services and information and cultural industries.[27] Low-skill services consist mainly of establishments in transportation, warehousing, wholesale trade, retail trade and consumer services, real estate, rental and leasing operations. While 31% of employees in high-skill services have a university degree, the corresponding proportions are only 11% in low-skill services and 16% in all industries of the private sector.[28]

VI.2 Regression analysis

Despite the aforementioned caveat, we use the Tobit model in order to allow a comparison of our results with those of Cappelli and Neumark (2001b) and Batt et al. (2002). However, we test the robustness of our results by also estimating sample selection models and Cragg's model for a subset of specifications.

In all models estimated in this section, we use the following set of controls: average wages in year t-1, industry, establishment size, whether the establishment belongs to a multi-establishment company, the percentage of unionized workers, the percentage of part-time workers, the percentage of temporary workers, the occupational composition of the workforce, average weekly hours of full-time employees, the unemployment rate of males 25-54 by economic region, the presence of a formal grievance system, whether the establishment was

[27] Business services include industries such as professional, scientific and technical services, of which computer systems design and related services are a component. Information and cultural industries include industries such as telecommunications, publishing and broadcasting.

[28] High-skill services, low-skill services and manufacturing account for 22%, 44% and 27% of total employment in our sample, respectively. The remaining 7% is accounted for by construction, forestry, mining, oil and gas extraction.

operating in 1997-1998 or in 1996 or earlier and whether employment fell in year t-1 (i.e. between March 1998 and March 1999).[29]

VI.2.1 Work practices considered individually

Table 9 shows results of Tobit analyses performed on establishments with more than 10 employees. Regression analyses are performed for all industries as well as for the three following sectors: manufacturing, high-skill services and low-skill services.

The first column of Table 9 indicates that in the aggregate, establishments which pay relatively high wages and which are unionized have lower quit rates than others. In contrast, establishments with a high percentage of part-time workers and those whose employment fell last year have higher quit rates than others.[30] Having performance-based pay systems is not associated with significant effects while having teamwork-related formal training is associated with higher quit rates. Most important, establishments which adopted problem-solving teams, self-directed workgroups or flexible job design in 1996 or earlier and were still using these practices in 1999 have lower quit rates than those which did not use these practices in 1999.[31] However, quite different patterns are observed among establishments which adopted work practices later, i.e. in 1997-1998. Specifically, those which implemented problem-solving teams during that period have higher quit rates than those with no problem-solving teams in 1999. This confirms the need to distinguish early adopters from late adopters when analyzing quit patterns.

The relationships documented above do not necessarily apply uniformly across sectors. The most robust pattern observed is the negative association between quit rates and the early adoption of self-directed workgroups: this negative association appears to hold in all three sectors, at least at the 10% level of significance.[32] However, the early adoption of problem-solving teams is associated with lower quit rates only in high-skill services. Furthermore, there is very little

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[29] For the sample consisting of establishments with more than 10 employees (N=3,142), we use 14 categories for industry, four categories for establishment size (10-19 employees, 20-99 employees, 100-499 employees and 500 or more employees) and seven variables representing the percentage of workers in a given occupational group (managers, professionals, technical/trades, marketing/sales, clerical/administrative, production workers with no trade/certification, other). Our measure of wages includes average annual pay per employee as well as average non-wage benefits per employee. We define a formal grievance system as a system where the final authority to settle disputes is held by either a labour-management committee or an outside arbitrator. We control for whether an establishment was operating in 1997-1998 or in 1996 or earlier to account for the possibility that workplaces which adopted teamwork and/or flexible job design in 1996 or earlier may have lower quit rates than those which did so in 1997-1998 simply because they are older establishments. All control variables are taken at the time of the first interview, i.e. in 1999.

[30] The finding that establishments whose employment fell last year have higher quit rates than others likely reflects the fact that workers quit firms whose performance is deteriorating to avoid being laid-off in the near future.

[31] Since the year of implementation of work practices is sometimes unknown, our set of covariates also includes indicators of whether or not an establishment adopted problem-solving teams, self-directed workgroups or flexible job design at an unknown date in the past. For a given practice, the reference group consists of establishments which are not using that practice in 1999.

[32] Cappelli and Neumark (2001b) also find a negative relationship between self-managed teams and quit rates in manufacturing.

evidence that performance-based pay systems and teamwork-related formal training are associated with lower quit rates: only establishments operating in high-skill services and having profit sharing/gain sharing plans have lower quit rates than others.

Among establishments with 50 or more employees, the early adoption of self-directed workgroups is no longer associated with lower quit rates (Table 10, column 1). Furthermore, it is hard to find a work practice yielding consistently negative and statistically significant correlations with quit rates across sectors. The only exception is profit sharing/gain sharing, which is associated with lower employee turnover in both high-skill services and low-skill services. In sum, relatively low quit rates are generally found in establishments with more than 10 employees which adopted self-directed workgroups in 1996 or earlier and among establishments with 50 or more employees which have profit sharing or gain sharing.

VI.2.2 Joint implementation of work practices

Skeptics might argue that the results of Tables 9 and 10 do not provide a satisfactory test of the impact of key AWPs on quit rates since they consider work practices individually, thereby neglecting potential synergies between these and other practices.[33] To take this argument into account, we analyze the impact of bundles of work practices in Table 11.

The 13 bundles considered in Table 11 include various combinations of the six following practices: 1) problem-solving teams adopted in 1996 or earlier and still in use in 1999, 2) self-directed workgroups adopted in 1996 or earlier and still in use in 1999, 3) flexible job design adopted in 1996 or earlier and still in use in 1999, 4) profit sharing or gain sharing in use in 1999, 5) merit pay or skill-based pay in use in 1999 and, 6) teamwork-related formal training in use in 1999. To maintain a constant control group across bundles, we use as a control group establishments which have *none* of the six aforementioned practices in 1999. In other terms, we ask the following question: compared to establishments which have none of the six practices, do establishments which have a given bundle of work practices have lower quit rates.[34] We ask that question for each of the 13 bundles considered, each of the three aforementioned industrial groupings and the two size categories, thereby estimating 78 separate Tobit models.

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[33] Another potential caveat is that Tables 9 and 10 consider work practices individually, *conditional* on the presence/absence of other AWPs. Since many of these practices may be implemented together, conditioning results on the presence/absence of other AWPs may lead to multicollinearity problems. To account for this possiblity, we also estimate separate Tobit models where a single work practice (e.g. self-directed workgroups adopted in 1996 or earlier) is considered and where results are *not* conditioned on the presence/absence of other AWPs. When we do so, the main message of Tables 9 and 10—i.e. the lack of uniformity of patterns across sectors—still holds.

[34] For each of the bundles considered, there is also an intermediate group of establishments, which neither have the bundle nor fall into the control group. Unlike the control group, the intermediate group varies across bundles. Therefore, for each of the bundles considered, the regressions include: 1) an indicator of whether or not an establishment has a given bundle and, 2) an indicator of whether or not an establishment falls into the intermediate group. The omitted category is the control group. Among establishments with more than 10 employees, the percentage of establishments which fall into the control group varies between 29% and 36%, depending on the industrial sector considered. The corresponding numbers for establishments with 50 or more employees are 17% and 22%, respectively.

Table 11 presents the coefficients associated with each of the 13 bundles, i.e. the coefficients associated with a dummy variable indicating whether or not an establishment has a given bundle. The results are striking. In manufacturing and for both size categories, there is no evidence that key AWPs reduce quit rates: none of the 13 bundles considered yields a negative and statistically significant correlation.

Quite different patterns are found in the service sector. Among establishments with more than 10 employees operating in low-skill services, there is a negative association between bundles of work practices and quit rates for about half of the bundles considered. By far, the strongest evidence of a negative association is found in high-skill services, where all except two bundles are statistically significant at the 5% level. Although the number of significant and negative bundles drops when we consider establishments with 50 or more employees in the two service sectors, the evidence in favour of a negative association remains fairly strong in high-skill services.

To ensure that our results do not depend critically on our use of the Tobit model, we replicate part of our analysis using the sample selection model and Cragg's (1971) model. Specifically, we re-estimate the "effect" of teamwork broadly defined and performance-based pay systems (i.e. bundles 24 and 25) for establishments of more than 10 employees operating in high-skill services. For all three econometric models (Tobit model, sample selection model and Cragg's model), we calculate the expected quit rates of establishments with a given bundle and those of establishments with none of the six practices defined above.[35] For both the sample selection model and Cragg's model, we estimate both an unrestricted version of the probit model and a restricted version where only establishment size and a multi-establishment indicator are assumed to influence the probability of having positive quits. The results are presented in Table 12.

While the magnitude of the effects does vary across econometric models, the expected quit rates of establishments which combine teamwork and performance-based pay systems are—whatever econometric model is used—at least 5 percentage points lower than those of establishments with none of the six practices.[36] Hence, our finding that teamwork and performance-based pay systems are associated with lower quit rates in high-skill services is robust to the choice of econometric models. [37]

To investigate further the robustness of these patterns, we re-estimate all models of Table 11 simply adding an indicator of whether establishments adopted a formal policy of information sharing in 1996 or earlier and still used it in 1999. When we do so, the results found in Table 11 in manufacturing remain unchanged. Specifically, the finding that none of the 13 bundles yields a negative and statistically significant correlation holds, information sharing having no

[35] We condition our results on the average values of the remaining covariates.

[36] The largest "effects" are found in the unrestricted versions of the sample selection model and Cragg's model, in which the coefficient associated with a given bundle is negative but not statistically significant at conventional levels in the probit equation (although it is in the conditional quit rate equation). More moderate effects are found in the restricted versions of these models. Detailed regression results are available upon request.

[37] Our finding that teamwork and performance-based pay systems are *not* associated with lower quit rates in manufacturing also holds when using the sample selection model and Cragg's model.

significant effect in most of the models. Accordingly, we show the results of this exercise for high-skill services and low-skill services only.

In columns 1 and 3 of Table 13, we first replicate the numbers shown in columns 5-6 of Table 11 for low-skill services, i.e. present Tobit coefficients without the information sharing indicator. Columns 2 and 4 show the Tobit coefficients with the information sharing indicator. Adding information sharing to the bundles previously defined sharply reduces the evidence of a negative association between these bundles and quit rates. Among establishments with more than 10 employees, the number of bundles implying a negative association drops from 7 to 3. Among establishments with 50 or more employees, there is no longer evidence of a negative association.

The story is different in high skill-services. For both size categories, adding information sharing reduces the number and the magnitude (in absolute value) of the significant negative correlations but even when the information sharing indicator is included, about two thirds of the bundles remain statistically significant among establishments with more than 10 employees. Therefore, the most robust evidence of a negative association between key AWPs and quit rates is found among establishments with 10 or more employees operating in high skill-services.[38]

To evaluate the magnitude of this association, we use the Tobit coefficients of column 6 of Table 13 and calculate the expected quit rates of establishments employing 10 or more employees in high-skill services. We do so for two bundles of work practices which combined teamwork—narrowly or broadly defined—with flexible job design (bundles 13 and 23, respectively). Since information sharing is common among establishments which have these bundles, we calculate the expected quit rates assuming that establishments have a formal information sharing policy. The results are shown in Table 14.

For both bundles, the expected quit rates of establishments with teamwork and flexible job design vary between 5% and 7%. In contrast, establishments with none of the six aforementioned practices have expected quit rates equal to 12%. Thus, having teamwork and flexible job design appears to have a sizable impact on labour turnover in high-skill services.

Since most establishments which have self-directed workgroups, problem-solving teams or flexible job design also have information sharing as a formal policy (Table 3), one might argue that the negative effect obtained for information sharing in low-skill services simply captures the impact of teamwork and/or flexible job design. To investigate this hypothesis, we estimate a Tobit model on a subsample of establishments employing more than 10 workers in low-skill services and which had implemented *neither* problem-solving teams, self-directed workgroups *nor* flexible job design in 1996 or earlier (N= 751). The resulting coefficient for information sharing equals -0.074 and is statistically significant at the 1% level.

The second panel of Table 14 presents expected quit rates for this subsample. Among establishments which implemented information sharing in 1996 or earlier, expected quit rates are 14%. In contrast, expected quit rates are 20% for other workplaces. Since we find a sizable

[38] For high-skill services, we re-estimated the models of Table 11 adding not only information sharing, but also two indicators of whether establishments had adopted task teams/joint labour-management committees or employee suggestion programs in 1996 or earlier and were still using these practices in 1999. Doing so did not alter this conclusion.

effect for information sharing even among establishments which adopted neither teamwork nor flexible job design in 1996 or earlier, the negative effect obtained for information sharing in low-skill services does not simply capture the impact of teamwork and/or flexible job design.

VI.2.3 Estimation of interaction terms

So far, we have examined whether the joint implementation of key AWPs is associated with lower quit rates. By doing so, we have presented statistics which combine both the main effect of a given practice A and interactive effects of practice A with other practices but we have not estimated interactive effects. Doing so is important since our finding that the joint implementation of work practices is not associated with lower quit rates in manufacturing, does not necessarily imply that there are no synergies between AWPs in this sector. It may simply reflect the fact that interactive effects tend to reduce quit rates but that main effects operate in opposite directions.

The three hypotheses outlined above (H1-H3) imply negative and statistically significant interaction terms. In Table 15, we present these interactive effects for each of the eight bundles which combine two AWPs.

To do so, we re-estimate Tobit models in the following way. For each of the eight bundles 13-26, we simply add to our set of controls three dummy variables representing the main effect of practice A, the main effect of practice B and interactions between A and B, respectively. For instance, when considering bundle 13, we add to our control variables 3 dichotomous variables representing the use of self-directed workgroups (adopted in 1996 or earlier), the use of flexible job design (adopted in 1996 or earlier) and an interaction term between these two practices. We perform this exercise for each of the eight bundles 13-26, for three sectors and two size categories, thereby estimating 48 Tobit models.

Once again, the patterns observed differ substantially across industries. In establishments with 50 or more employees operating in high-skill services, there appears to be synergies between teamwork and merit pay/skill-based pay or teamwork-related formal training. The complementarity between teamwork and teamwork-related formal training (bundles 16 and 26) is worth noting since it is estimated precisely, being statistically significant at the 1% level. In manufacturing establishments with more than 10 employees, synergies between teamwork and flexible job design (bundle 13) are also estimated precisely. In low-skill services, we find little evidence of synergies since only interactions between teamwork broadly defined and profit sharing/gain sharing (bundle 24) are negative and statistically significant at the 10% level.

VI.2.4 Discussion

Taken together, Tables 7-15 suggest several stories. One interpretation of the negative correlations found in high-skill services is that key AWPs may be more successful in reducing quit rates in technologically complex work environments, i.e. in firms which employ a highly skilled workforce, require strong conceptual/analytical skills and de-emphasize repetitive tasks.

One explanation for the decrease in correlations (in absolute value) observed in low-skill and high-skill services when we add information sharing could be that the information sharing

indicator is a proxy for policies which signal employers' interest in workers' well-being. If so, such policies may also be useful tools for achieving reductions in labour turnover. Alternatively, workers whose employers have a formal policy of information sharing (on firm's performance, organizational changes, etc.) may *perceive* that they work in a less uncertain environment than others. If so, the perceived reduction in uncertainty might induce them to keep working with their current employer.

VII. Summary and conclusions

Using a nationally representative sample of establishments, this study has examined whether key AWPs tend to reduce quit rates. Overall, the analysis provides:

1. strong evidence of a negative association between key AWPs and quit rates among establishments of more than 10 employees operating in high-skill services;
2. some evidence of a negative association in low-skill services. However, the magnitude of this negative association is reduced substantially when we simply add an indicator of whether the workplace has a formal policy of information sharing;
3. very little evidence of a negative association in manufacturing. While establishments with self-directed workgroups have lower quit rates than others, none of the bundles of work practices considered yields a negative and statistically significant effect.

Overall, the findings presented in this paper paint a rather complex picture of the relationship between key AWPs and quit rates. The evidence suggests that these practices appear to reduce quit rates in high-skill services and is therefore consistent with the findings of Batt et al. (2002), which show a negative association between teamwork and quit rates in telecommunications in the U.S. Whether these practices operate in a similar way in low-skill services remains an open question. Consistent with the findings of Cappelli and Neumark (2001b), self-directed workgroups, considered in isolation, appear to be associated with lower quit rates in manufacturing. However, we find no further evidence that key AWPs reduce quit rates in this sector.

Our interpretation of the negative correlations obtained for information sharing in low-skill services is that this variable might proxy the use of practices—that some might label "conventional"—which send employees a clear signal of their employer's interest in their well-being. If so, such practices, whatever they are, might be successful in reducing labour turnover in traditional/low-skill work environments.

Taken together, the findings obtained for high-skill services and low-skill services suggest that key AWPs might be more successful in reducing labour turnover in technologically complex environments than in low-skill ones.[39]

Yet, alternative interpretations must be kept in mind. The negative association found in cross-sectional data between key AWPs and quit rates in high-skill services does not necessarily imply that adopting these practices causes a reduction in quit rates in this sector. As mentioned above,

[39] Boning et al. (2001) find that the adoption of teamwork in U.S. steel minimills leads to larger productivity increases in technologically complex production lines than in other production lines.

establishments with AWPs in high-skill services may have had lower quit rates than others even *before* they adopted these practices. Second, establishments which use these practices may simply have better managers than others and it might the quality of management—rather than the adoption of these practices—which causes a reduction in quit rates.[40]

Given the demographic pressures firms will face in the near future as a result of the aging of their workforce, the search for work practices which reduce labour turnover will likely intensify over the next few years. The markedly different patterns that this paper has documented across industries and the possibility that other confounding factors underlie the correlations found in high-skill services suggest that it is still premature to conclude that key AWPs are the magic tool one may be looking for to achieve a substantial reduction in quit rates in all sectors of the economy.

[40] It is also important to acknowledge that *if* AWPs caused a reduction in quit rates in high-skill services, the magnitude of the impact will be overestimated if some of the establishments which adopted these practices have abandoned them later because they did not prove successful in reducing quit rates.

Table 1: Percentage of Establishments with Selected Work Practices, 1999*.

Practice	Establishments with more than 10 employees (N=3,142)	Period of implementation %			
		1997-1998	1996 or earlier	Missing date	After 1975
1. Teamwork					
a) Problem-solving teams	25	6	16	3	21
b) Self-directed workgroups	10	2	7	1	8
2. Flexible job design	32	6	23	3	26
3. Performance-based pay systems					
a) Profit sharing or gain sharing	22	n.a.	n.a.	n.a.	n.a.
b) Merit pay or skill-based pay	30	n.a.	n.a.	n.a.	n.a.
4. Teamwork-related formal training	23	n.a.	n.a.	n.a.	n.a.
Tasks teams and joint labour-management committees	18	4	10	3	13
Employee suggestion program	30	9	18	4	25
Information sharing	48	9	32	7	38
Teamwork or flexible job design	44				

Practice	Establishments with 50 or more employees (N=1,890)	Period of implementation %			
		1997-1998	1996 or earlier	Missing date	After 1975
1. Teamwork					
a) Problem-solving teams	33	8	20	4	27
b) Self-directed workgroups	15	2	11	2	12
2. Flexible job design	24	6	15	3	19
3. Performance-based pay systems					
a) Profit sharing or gain sharing	32	n.a.	n.a.	n.a.	n.a.
b) Merit pay or skill-based pay	38	n.a.	n.a.	n.a.	n.a.
4. Teamwork-related formal training	43	n.a.	n.a.	n.a.	n.a.
Tasks teams and joint labour-management committees	34	4	25	5	26
Employee suggestion program	38	11	23	4	32
Information sharing	51	8	34	10	38
Teamwork or flexible job design	45				

* Establishments still in operation in 2000.

n.a. : not available.

Source : Workplace and Employee Survey of 1999-2000.

Table 2: Percentage of Establishments with Selected Work Practices, by Industry, Size and Union Status , 1999*.

	1. Teamwork			2. Performance-based pay systems					
Practice	Problem solving teams	Self-directed work groups	Flexible job design	Profit or gain sharing	Merit pay or skill-based pay	Teamwork related formal training	Task teams and joint l-m committees	Employee suggestion programs	Informa-tion sharing
Industry									
Forestry, mining, oil and gas extraction	16	34	32	21	29	17	35	34	62
Construction	25	8	22	21	36	7	18	21	34
Manufacturing	27	10	25	24	29	16	21	26	42
High-skill services	23	13	23	24	35	23	19	31	53
Low-skill services	26	8	39	21	28	27	15	33	48
Establishment size									
10-49 employees	23	9	34	20	29	19	14	29	47
50-99 employees	33	15	26	26	37	38	31	39	47
100-499 employees	31	14	19	41	40	48	36	37	56
500+ employees	48	22	31	49	50	66	59	44	74
Establishment unionized?									
No	24	10	34	23	32	22	13	31	47
Yes	30	8	22	18	24	28	42	27	52
All (N=3,142)	**25**	**10**	**32**	**22**	**30**	**23**	**18**	**30**	**48**

* Establishments still in operation in 2000.
Source : Workplace and Employee Survey of 1999-2000.

Table 3: Use of Other Work Practices for Establishments with a Given Practice, 1999.**

Use of other practices (%) / Establishments with a given practice (%)	1. Teamwork			3. Performance-based pay systems					
	1a* Problem solving teams	1b* Self-directed work groups	2* Flexible job design	3a Profit or gain sharing	3b Merit pay or skill-based pay	4 Teamwork related formal training	Task teams and joint l-m committees*	Employee suggestion programs*	Informa-tion sharing*
1. Teamwork									
a) Problem-solving teams	-	22	46	35	40	41	30	52	81
b) Self-directed workgroups	46	-	76	56	57	31	44	38	87
2. Flexible job design	31	24	-	28	43	24	20	44	69
3. Performance-based pay systems									
a) Profit sharing or gain sharing	25	19	29	-	51	42	14	25	45
b) Merit pay or skill-based pay	20	14	33	36	-	28	14	21	38
4. Teamwork-related formal training	28	10	24	40	37	-	18	29	41
Tasks teams and joint labour-management committees	45	31	44	29	40	39	-	53	71
Employee suggestion program	44	15	55	30	35	35	30	-	75
Information sharing	40	20	51	31	36	29	23	44	-

** Establishments still in operation in 2000 (N=3,142).

* Practice adopted in 1996 or earlier and still in use in 1999.

The table reads as follows: of all establishments which had problem-solving teams in 1996 or earlier, 22% had self-directed workgroups in 1996 or earlier, 46% had flexible job design in 1996 or earlier, ... and 41% had teamwork-related formal training in 1999.

Source : Workplace and Employee Survey of 1999-2000.

Table 4: Percentage of establishments with bundles of work practices.

	Percentage of establishments with bundles of practices adopted in 1996 or earlier and still in use in 1999		Percentage of establishments with bundles of practices in use in 1999	
	(1) Establishments with > 10 employees	(2) Establishments with >= 50 employees	(3) Establishments with > 10 employees	(4) Establishments with >= 50 employees
Bundle no. :				
13	6	5	7	8
14	4	4	5	6
15	4	6	5	9
16	2	7	3	10
23	10	9	18	16
24	8	8	10	12
25	8	11	11	14
26	7	16	11	24
234	5	3	6	5
235	5	6	7	8
236	3	6	6	11
2346	2	2	3	3
2356	1	4	2	5
Observations	3,142	1,890	3,142	1,890

1= self-directed workgroups; 2= self-directed workgroups or problem-solving teams; 3= flexible job design;
4= profit sharing or gain sharing; 5= merit-pay or skill-based pay; 6= teamwork-related formal training.
The table reads as follows:
Bundle 13 refers to establishments which have both self-directed workgroups and flexible job design.
Bundle 23 refers to establishments which have either self-directed workgroups or problem-solving teams (or both) and flexible job design.
Bundle 2356 refers to establishments which have bundle 23 as well as merit pay/skill-based pay *and* teamwork-related formal training.
Source : Workplace and Employee Survey of 1999-2000.

Table 5 : Average Quit rates by Work Practice (%).

Practice	Establishments with more than 10 employees (N=3,142) (1) Adopted practice in 1996 or earlier and still had it in 1999	(2) Did not have practice in 1999
1. Teamwork		
a) Problem-solving teams*	11	14
b) Self-directed workgroups*	10	15
2. Flexible job design	14	14
Task teams and joint labour-management committees*	8	16
Employee suggestion program*	13	14
Information sharing*	10	17
Information sharing - establishments with no teamwork, flexible job design or task teams*	8	17
	(1)	(2)
3. Performance-based pay systems	Yes	No
a) Profit sharing or gain sharing in 1999?	13	15
b) Merit pay or skill-based pay in 1999?	13	15
4. Teamwork-related formal training in 1999?	18	14
Average quit rate **15**		

Practice	Establishments with 50 or more employees (N=1,890) (1) Adopted practice in 1996 or earlier and still had it in 1999	(2) Did not have practice in 1999
1. Teamwork		
a) Problem-solving teams*	13	14
b) Self-directed workgroups*	12	14
2. Flexible job design*	14	13
Task teams and joint labour-management committees*	11	14
Employee suggestion program*	13	13
Information sharing*	12	15
Information sharing - establishments with no teamwork, flexible job design or task teams*	12	15
	(1)	(2)
3. Performance-based pay systems	Yes	No
a) Profit sharing or gain sharing in 1999?	12	15
b) Merit pay or skill-based pay in 1999?	14	14
4. Teamwork-related formal training in 1999?	14	14
Average quit rate **14**		

* adopted in 1996 or earlier and still in use in 1999.

Source: Workplace and Employee Survey of 1999-2000.

Table 6: Quit rates by establishment size.

Establishment size*	(1) Percentage of establishments with positive quits P(Y2 > 0)	(2) Average quit rates of establishments with positive quits E(Y2 \ Y2 > 0)	(3) Percentage distribution of employment*
		Percentage	
1-19 employees	56	28	16
20-99	74	19	42
100-499	87	15	27
500 or more	81	11	15
[N=3,142]			

* in 1999.
Source: Workplace and Employee Survey of 1999-2000.

Table 7 : Average quit rates by industry and bundle of work practices - Establishments with more than 10 employees.

Industry	Manufacturing	High-skill services	Low-skill services	All industries
Bundle of work practices		%		
Teamwork & flexible job design*	11.8 (2.8)	2.8 (1.0)	13.6 (2.1)	11.6 (1.4)
Teamwork and profit sharing*	13.7 (2.6)	3.7 (1.1)	13.2 (1.7)	11.2 (1.4)
Teamwork and merit pay/skill-based pay*	13.0 (2.4)	4.3 (1.1)	12.7 (1.5)	9.6 (1.0)
Teamwork and formal training on teamwork*	15.8 (3.3)	6.1 (0.7)	14.6 (2.0)	13.4 (1.4)
No alternative work practices**	10.7 (1.1)	15.8 (3.7)	19.3 (1.9)	15.5 (1.4)

* Teamwork and flexible job design adopted in 1996 or earlier and still in use in 1999. Profit sharing, merit pay/skill-based pay and formal training on teamwork in use in 1999. Teamwork refers to problem-solving teams or self-directed workgroups. Bootstrap standard errors are between parentheses.

** : establishments with none of the following practices :

1) problem-solving teams adopted in 1996 or earlier and still in use in 1999
2) self-directed workgroups adopted in 1996 or earlier and still in use in 1999
3) flexible job design adopted in 1996 or earlier and still in use in 1999
4) profit sharing or gain sharing in use in 1999
5) merit pay or skill-based pay in use in 1999
6) teamwork-related formal training in use in 1999.

Table 8 : Average quit rates - Establishments with no teamwork or flexible job design adopted in 1996 or earlier.*

Industry	Manufacturing	High-skill services	Low-skill services	All industries
Information sharing adopted in 1996 or earlier and still in use in 1999 ?		%		
Yes	8.7 (1.1)	10.4 (2.3)	8.4 (1.3)	8.7 (0.9)
No	12.1 (0.9)	15.9 (2.6)	20.2 (2.2)	16.7 (1.3)

* Establishments with more than 10 employees. Bootstrap standard errors are between parentheses.

Table 9: Selected AWPs and quit rates, establishments with more than 10 employees.

		All industries (1)	Manufacturing (2)	High-skill services (3)	Low-skill services (4)
I. Teamwork and flexible job design					
Problem-solving teams	<= 1996	-0.046****	-0.007	-0.167****	-0.021
		0.013	*0.021*	*0.028*	*0.022*
Self-directed workgroups	<= 1996	-0.049***	-0.081**	-0.071*	-0.058*
		0.019	*0.033*	*0.041*	*0.031*
Flexible job design	<= 1996	-0.023**	0.054***	-0.097****	-0.046**
		0.012	*0.019*	*0.030*	*0.019*
Problem-solving teams	1997-1998	0.170****	-0.034	0.095	0.253****
		0.021	*0.025*	*0.062*	*0.037*
Self-directed workgroups	1997-1998	-0.014	0.056	0.087	-0.069
		0.035	*0.041*	*0.061*	*0.081*
Flexible job design	1997-1998	0.036*	0.003	-0.178**	0.045
		0.022	*0.032*	*0.061*	*0.038*
II. Performance-based pay systems and training					
Profit sharing or gain sharing		-0.018	0.037**	-0.055**	0.005
		0.012	*0.018*	*0.025*	*0.021*
Merit pay or skill-based pay		0.003	-0.014	0.067***	0.008
		0.010	*0.016*	*0.021*	*0.017*
Teamwork-related formal training		0.027**	0.057***	-0.004	0.009
		0.012	*0.021*	*0.023*	*0.019*
III. Selected controls					
Wages		-0.0010****	-0.0007*	0.0007	-0.0022****
		0.0003	*0.0004*	*0.0005*	*0.0006*
Percentage unionized workers		-0.095****	-0.108***	-0.038	-0.057
		0.022	*0.037*	*0.048*	*0.037*
Percentage of part-time workers		0.178****	0.001	0.085*	0.209****
		0.023	*0.054*	*0.053*	*0.036*
Employment fell last year		0.059****	0.027	0.134****	-0.012
		0.011	*0.018*	*0.025*	*0.019*
Observations		3,142	866	709	1,079
Likelihood Ratio Chi Square		844.47	136.11	265.24	478.29

Other controls include : industry (3-14 categories); establishment size (4 categories); occupation; percentage of temporary employees; average weekly hours of full-time employees; unemployment rate of males 25-54 by economic region; whether the establishment is the branch of a company; presence of a formal grievance system; whether the establishment was operating in 1997-1998 or in 1996 or earlier.

- Standard errors of coefficients are in italics.

* : significant at the 10% level; ** : significant at the 5% level; *** : significant at the 1% level; **** : significant at the 0.1% level.

Source: Workplace and Employee Survey of 1999-2000.

Table 10: Selected AWPs and quit rates, establishments with 50 or more employees.

		All industries (1)	Manufacturing (2)	High-skill services (3)	Low-skill services (4)
I. Teamwork and flexible job design					
Problem-solving teams	<= 1996	-0.014	-0.025	-0.044**	-0.006
		0.013	*0.022*	*0.021*	*0.023*
Self-directed workgroups	<= 1996	-0.011	-0.050*	-0.007	0.026
		0.016	*0.030*	*0.022*	*0.030*
Flexible job design	<= 1996	-0.023	0.038	-0.032	-0.059**
		0.013	*0.023*	*0.023*	*0.024*
Problem-solving teams	1997-1998	-0.038	-0.096***	0.095***	-0.055
		0.019	*0.034*	*0.035*	*0.034*
Self-directed workgroups	1997-1998	0.089	-0.041	0.086**	0.070
		0.029	*0.069*	*0.035*	*0.053*
Flexible job design	1997-1998	-0.029	0.058	-0.028	-0.019
		0.022	*0.049*	*0.051*	*0.034*
II. Performance-based pay systems and training					
Profit sharing or gain sharing		-0.038****	-0.023	-0.039***	-0.039**
		0.010	*0.018*	*0.015*	*0.019*
Merit pay or skill-based pay		0.003	0.018	0.006	-0.013
		0.010	*0.018*	*0.015*	*0.019*
Teamwork-related formal training		0.020	0.033	0.030*	-0.005
		0.010	*0.022*	*0.016*	*0.018*
III. Selected controls					
Wages		-0.0004	-0.0017****	0.0011***	-0.0003
		0.0003	*0.0005*	*0.0004*	*0.0006*
Percentage unionized workers		-0.061	-0.093***	-0.044	-0.071**
		0.018	*0.032*	*0.034*	*0.033*
Percentage of part-time workers		0.072	-0.145*	0.131***	0.111***
		0.023	*0.086*	*0.043*	*0.036*
Employment fell last year		0.012	0.010	0.036**	0.022
		0.010	*0.019*	*0.018*	*0.018*
Observations		1890	606	419	631
Likelihood Ratio Chi Square		414.66	175.17	167.97	172.48

Other controls include : industry (3-14 categories); establishment size (3 categories); occupation; percentage of temporary employees; average weekly hours of full-time employees; unemployment rate of males 25-54 by economic region; whether the establishment is the branch of a company; presence of a formal grievance system; whether the establishment was operating in 1997-1998 or in 1996 or earlier.

- Standard errors of coefficients are in italics.

* : significant at the 10% level; ** : significant at the 5% level; *** : significant at the 1% level; **** : significant at the 0.1% level.

Source: Workplace and Employee Survey of 1999-2000.

Table 11: Bundles of work practices and quit rates.

	Establishments with >10 employees	Establishments with >=50 employees	Establishments with >10 employees	Establishments with >=50 employees	Establishments with >10 employees	Establishments with >=50 employees
Industry	Manufacturing		High-skill services		Low-skill services	
	(1)	(2)	(3)	(4)	(5)	(6)
Bundles with components*						
13	0.046	0.002	**-0.200****	**-0.101****	**-0.162****	-0.001
14	-0.020	-0.002	**-0.216****	-0.027	**-0.143****	-0.047
15	0.025	-0.042	**-0.166****	**-0.056***	-0.044	-0.015
16	-0.012	-0.018	**-0.253*****	**-0.064***	-0.078	-0.011
23	0.031	0.026	**-0.169****	**-0.069****	**-0.124****	-0.030
24	0.078*****	-0.021	**-0.123*****	-0.030	**-0.150****	**-0.056***
25	0.064****	0.024	**-0.120****	**-0.059****	**-0.103****	-0.012
26	0.113*****	0.039	**-0.076***	-0.043	-0.075****	0.010
234	0.033	-0.053	**-0.231****	-0.034	**-0.101*****	-0.043
235	0.058	0.091****	**-0.196****	**-0.097*****	**-0.132****	-0.016
236	0.077*	0.003	**-0.243*****	**-0.090****	-0.036	-0.011
2346	0.091*	-0.041	-0.148	-0.024	-0.030	-0.031
2356	-0.029	-0.027	**-0.217****	**-0.101*****	-0.072	-0.030

* Components of bundles are defined as follows :

1= self-directed workgroups adopted in 1996 or earlier and still in use in 1999

2= self-directed workgroups or problem-solving teams adopted in 1996 or earlier and still in use in 1999

3= flexible job design adopted in 1996 or earlier and still in use in 1999

4= profit sharing or gain sharing in use in 1999

5= merit pay or skill-based pay in use in 1999

6= teamwork-related formal training in use in 1999.

* : significant at the 10% level; ** : significant at the 5% level; *** : significant at the 1% level; **** : significant at the 0.1% level.

Table 12: Expected quit rates in high-skill services, various models.*

Bundle with components:	Econometric model	Establishments with none of the 6 practices** (1)	%	Establishments with bundle (2)
24	Tobit model	17		9
	Sample selection model - unrestricted Probit	20		5
	Sample selection model - restricted Probit	16		8
	Cragg's model - unrestricted Probit	14		3
	Cragg's model - restricted Probit	11		5
25	Tobit model	17		9
	Sample selection model - unrestricted Probit	20		6
	Sample selection model - restricted Probit	16		8
	Cragg's model - unrestricted Probit	14		5
	Cragg's model - restricted Probit	11		6

* Establishments with more than 10 employees. Components of bundles are defined as follows:
2= self-directed workgroups or problem-solving teams adopted in 1996 or earlier and still in use in 1999
4= profit sharing or gain sharing in use in 1999
5= merit pay or skill-based pay in use in 1999.
** : problem-solving teams (1996 or earlier), self-directed workgroups (1996 or earlier), flexible job design (1996 or earlier), profit-sharing or gain sharing, merit pay or skill-based pay and, teamwork-related formal training.

Source: Authors' calculations from the Workplace and Employee Survey of 1999-2000.

Table 13: Bundles of work practices, information sharing and quit rates.

	Establishments with > 10 employees	Establishments with > 10 employees	Establishments with >=50 employees	Establishments with >=50 employees	Establishments with > 10 employees	Establishments with > 10 employees	Establishments with >=50 employees	Establishments with >=50 employees
Industry	**Low-skill services**		**Low-skill services**		**High-skill services**		**High-skill services**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Information sharing indicator included ?	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**
Bundles with components*								
13	**-0.162****	**-0.093*****	-0.001	0.050	**-0.200****	**-0.138*****	**-0.101****	**-0.087****
14	**-0.143****	**-0.071***	-0.047	-0.004	**-0.216****	**-0.149****	-0.027	-0.008
15	-0.044	0.029	-0.015	0.034	**-0.166****	**-0.101****	**-0.056***	-0.041
16	-0.078	-0.019	-0.011	0.032	**-0.253****	**-0.182****	**-0.064***	-0.049
23	**-0.124****	-0.048	-0.030	0.013	**-0.169****	**-0.106****	**-0.069****	-0.056
24	**-0.150****	**-0.078****	**-0.056***	0.019	**-0.123*****	-0.039	-0.030	-0.011
25	**-0.103****	-0.028	-0.012	0.031	**-0.120****	-0.043	**-0.059****	-0.054
26	-0.075**	0.005	0.010	0.073**	**-0.076***	0.001	-0.043	-0.032
234	**-0.101*****	-0.019	-0.043	0.040	**-0.231****	**-0.161****	-0.034	-0.013
235	**-0.132****	-0.059	-0.016	0.027	**-0.196****	**-0.130****	**-0.097*****	**-0.085****
236	-0.036	0.035	-0.011	0.036	**-0.243*****	**-0.170***	**-0.090****	**-0.078****
2346	-0.030	0.040	-0.031	0.015	-0.148	-0.074	-0.024	-0.0001
2356	-0.072	-0.022	-0.030	0.079*	**-0.217****	-0.145	**-0.101*****	**-0.089****

* Components of bundles are defined as follows :

1= self-directed workgroups adopted in 1996 or earlier and still in use in 1999

2= self-directed workgroups or problem-solving teams adopted in 1996 or earlier and still in use in 1999

3= flexible job design adopted in 1996 or earlier and still in use in 1999

4= profit sharing or gain sharing in use in 1999

5= merit pay or skill-based pay in use in 1999

6= teamwork-related formal training in use in 1999

* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level, **** significant at the 0.1% level

Table 14: Expected quit rates in high-skill services and low-skill services.

I. Establishments with more than 10 employees in high-skill services and with an information sharing policy

	Establishments with none of the 6 practices** (1)	%	Establishments with bundle (2)
Bundle with components* :			
13	12		5 [7]
23	12		7 [9]

II. Establishments with more than 10 employees in low-skill services and with neither problem-solving teams, self-directed workgroups, nor flexible job design in 1996 or earlier (N=751)

	No (3)	Yes (4)
Information sharing in 1996 or earlier	20	14 [12]

* Components of bundles are defined as follows:
1= self-directed workgroups adopted in 1996 or earlier and still in use in 1999
2= self-directed workgroups or problem-solving teams adopted in 1996 or earlier and still in use in 1999
3= flexible job design adopted in 1996 or earlier and still in use in 1999
** : problem-solving teams (1996 or earlier), self-directed workgroups (1996 or earlier), flexible job design (1996 or earlier), profit-sharing or gain sharing, merit pay or skill-based pay and, teamwork-related formal training.
The percentage of establishments with a given bundle (or with an information sharing policy) is in brackets.

Source : Authors' calculations from the Workplace and Employee Survey of 1999-2000.

Table 15: Interaction terms by sector.

	Establishments with > 10 employees	Establishments with >=50 employees	Establishments with > 10 employees	Establishments with >=50 employees	Establishments with > 10 employees	Establishments with >=50 employees
Industry	**Manufacturing**		**High-skill services**		**Low-skill services**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Interaction terms for bundles with components[a]:						
13	0.049	-0.037	-0.044	**-0.099****	-0.090	0.100*
14	**-0.133****	0.025	-0.070	0.046	-0.014	-0.042
15	0.036	**-0.092***	-0.073	**-0.096****	0.196*****	0.012
16	**-0.118****	-0.080	-0.098	**-0.131*****	0.029	0.024
23	**-0.147*****	-0.054	0.132**	-0.056	0.008	0.028
24	-0.009	**-0.074****	0.153***	0.053	**-0.080***	**-0.063***
25	0.022	-0.028	0.096**	**-0.085*****	0.017	0.001
26	0.033	0.004	0.195*****	**-0.095*****	-0.0001	0.062*

[a] Components of bundles are defined as follows:

1= self-directed workgroups adopted in 1996 or earlier and still in use in 1999

2= self-directed workgroups or problem-solving teams adopted in 1996 or earlier and still in use in 1999

3= flexible job design adopted in 1996 or earlier and still in use in 1999

4= profit sharing or gain sharing in use in 1999

5= merit pay or skill-based pay in use in 1999

6= teamwork-related formal training in use in 1999.

* : significant at the 10% level; ** : significant at the 5% level; *** : significant at the 1% level; **** : significant at the 0.1% level

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